PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY
(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference	FOR FURTHER ACTION See Form PCT/IPEA/416	
PC-21002066		
International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/SE2003/000514	31.03.2003	03.04.2002
International Patent Classification (IPC) or national classification and IPC		
E04F 15/04		
Applicant		
Välinge Innovation AB et al		

1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.
2. This REPORT consists of a total of 7 sheets, including this cover sheet.
3. This report is also accompanied by ANNEXES, comprising:
   a. ☒ *(sent to the applicant and to the International Bureau)* a total of 27 sheets, as follows:
      ☒ sheets of the description, claims and/or drawings which have been amended and are the basis of this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).
      ☐ sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.
   b. ☐ *(sent to the International Bureau only)* a total of (indicate type and number of electronic carrier(s)) _____, containing a sequence listing and/or tables related thereto, in computer readable form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).
4. This report contains indications relating to the following items:
   - ☒ Box No. I Basis of the report
   - ☐ Box No. II Priority
   - ☐ Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
   - ☐ Box No. IV Lack of unity of invention
   - ☒ Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
   - ☐ Box No. VI Certain documents cited
   - ☐ Box No. VII Certain defects in the international application
   - ☒ Box No. VIII Certain observations on the international application

Date of submission of the demand	Date of completion of this report
17.10.2003	23.06.2004
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INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No.
PCT/SE2003/000514

Box No. I Basis of the report

1. With regard to the **language**, this report is based on the international application in the language in which it was filed, unless otherwise indicated under this item.

☐ This report is based on a translation from the original language into the following language _____, which is the language of a translation furnished for the purposes of:

- ☐ international search (under Rules 12.3 and 23.1(b))
- ☐ publication of the international application (under Rule 12.4)
- ☐ international preliminary examination (under Rules 55.2 and/or 55.3)

2. With regard to the **elements** of the international application, this report is based on *(replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report):*

☐ the international application as originally filed/furnished

☒ the description:

pages 1-27 as originally filed/furnished
pages* 28-42 received by this Authority on 14.05.2004
pages* _____ received by this Authority on _____

☒ the claims:

pages _____ as originally filed/furnished
pages* _____ as amended (together with any statement) under Article 19
pages* 43-53 received by this Authority on 14.05.2004
pages* 54 received by this Authority on 17.10.2003

☒ the drawings:

pages 1-22 as originally filed/furnished
pages* _____ received by this Authority on _____
pages* _____ received by this Authority on _____

☐ a sequence listing and/or any related table(s) – see Supplemental Box Relating to Sequence Listing.

3. ☐ The amendments have resulted in the cancellation of:

- ☐ the description, pages _____
- ☐ the claims, Nos. _____
- ☐ the drawings, sheets/figs _____
- ☐ the sequence listing *(specify)*: _____
- ☐ any table(s) related to the sequence listing *(specify)*: _____

4. ☐ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).

- ☐ the description, pages _____
- ☐ the claims, Nos. _____
- ☐ the drawings, sheets/figs _____
- ☐ the sequence listing *(specify)*: _____
- ☐ any table(s) related to the sequence listing *(specify)*: _____

* *If item 4 applies, some or all of those sheets may be marked "superseded."*

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No.
PCT/SE2003/000514

Box No. V **Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

1. Statement

Novelty (N)	Claims	4-27, 29-41, 43, 45-52	YES
	Claims	1-3, 28, 42, 44	NO
Inventive step (IS)	Claims	4-10,12-13,24,27,30,32-41,43,45-47	YES
	Claims	1-3,11,14-23,25-26,28,29,31,42,44, 48-52	NO
Industrial applicability (IA)	Claims	1-52	YES
	Claims		NO

2. Citations and explanations (Rule 70.7)

The amendments to the description and the claims, submitted by the applicant, are considered not to introduce subject-matter that go beyond the disclosure of the application as filed.

Documents cited in the International Search Report and considered to be of particular interest:

D1: FR 2810060 A1
D2: DE 19601322 A1
D3: US 6203653 B1
D4: WO 0020705 A1
D5: WO 9966152 A1

D1 discloses a floorboard (1a) comprising connection means (5) which are integrated with the floorboard and adapted to connect the floorboard with an essentially identical floorboard (1b) in the same way as defined in this application. Said connecting means comprises a locking strip (5) which projects from the vertical plane between the two floorboards and carries a locking element (8) which is designed to cooperate with a locking groove (17b) of said essentially identical floorboard, said locking strip (5) consisting of a separate part which is arranged on the floorboard (1a), and said locking strip (5) being mechanically fixed to the floorboard (1a).

According to figure 3, the connecting means is designed to connect the floorboard with an essentially identical floorboard by inward angling. According to figure 4, the connection is made by snapping-in. Since the connection means is symmetrical, it is obvious that it is intended to be fixed

.../...

Supplemental Box

In case the space in any of the preceding boxes is not sufficient.
Continuation of: Box V

to the first floorboard by snapping-in and/or inward angling.

The connection means, according to the French document, is designed to disconnect the floorboards from each other by a motion in an opposite direction to the inward angling.

Thus, the subject matter of claims 1-3 lacks novelty and consequently also lacks an inventive step.

It is also considered that claim 28 (locking strip) lacks novelty and consequently also lacks an inventive step.

Since the locking strip (5), according to the French document is designed so as to allow the floorboard to be disconnected from it and since the locking strip (5) is symmetrical, it is obvious to a person skilled in the art that the locking strip (5) is detachable from its floorboard by an angular motion in an opposite direction to the inward angling.

Thus, the subject matter of claim 11 lacks an inventive step.

Floorboards are conventionally made of wood-based material, especially when the locking strip is machined directly in the floorboard material. Also, D2 discloses a connecting strip between floorboards, which strip is made of wood-based material. Therefore, it seems obvious to a person skilled in the art to make a locking strip according to D1 of wood-based material. Claims 14-15 and 18 are considered to lack an inventive step.

It seems obvious to a person skilled in the art that wood-based materials could be improved in their properties by impregnating or coating them with a suitable agent. Consequently, claims 16-17 are considered to lack an inventive step.

The subject matter of claims 19-22 seem to be obvious to a person skilled in the art in view of the disclosures of D1 and D5. Claims 19-22 are considered to lack an inventive step.

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Supplemental Box

In case the space in any of the preceding boxes is not sufficient.
Continuation of: Box V

Claims 23,25,26 define a method for manufacturing a floorboard comprising a connecting means, the steps of which are considered to be simple and straightforward ("forming the locking strip (6) as a separate part", "mechanically fixing the locking strip (6) to the floorboard").D1 does not disclose a method for manufacturing the floorboard but it clearly shows the individual parts (floorboard, locking strip) and it seems obvious that a person skilled in the art would make the floorboard comprising the locking strip by "forming the locking strip as a separate part", "mechanically fixing the locking strip to the floorboard", etc. In view of the disclosure of D1, it is thus considered that the method claimed in claims 23,25,26 lacks an inventive step.

The subject matter of claim 29 is considered to lack an inventive step, the arguments being analogous to the arguments relating to claims 14-15 and 18.

Claims 31 defines a method for manufacturing a locking strip, the steps of which are considered to be simple and straightforward ("forming the locking strip (6) for mechanical fixing to the floorboard", "forming the locking strip (6) for connecting the floorboard with the essentially identical floorboard",). D1 does not disclose a method for manufacturing the locking strip but it clearly shows the individual locking strip and it seems obvious that a person skilled in the art would make the locking strip by forming the locking strip according to claim 31. In view of the disclosure of D1, it is thus considered that the method claimed in this claim lacks an inventive step.

Claim 42 defines a set of parts for making a floorboard with connecting means. Apart from the leading sentence ("A set of parts for making...") it seems that this claim is substantially identical to claim 1. For the same reasons as regarding claim 1, claim 42 is also considered to lack novelty, and consequently also lacking an inventive step.

The floorboard according to claims 44-52 differs from the

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Supplemental Box

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Continuation of: Box V

floorboard according to claims 1-22 in that it is specifically stated that the locking strip is held in place in the strip groove (36) by frictional forces or by being glued thereto. It is considered that a person skilled in the art readily would substitute "mechanically fixing" (claims 1-22) with "frictional fixing" or with "gluing", these methods of fixing being obvious choices for the skilled artisan.

Therefore, it is considered that claim 44 lacks novelty and consequently, also lacks an inventive step for the same reasons as regarding claim 1.

Claims 48-52 are considered to lack an inventive step for the same reasons as claims 14- 18 respectively.

Box No. VIII Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

Claims 5 and 6 define a "locking surface (60)" arranged on the locking groove (36) and further, a "locking surface (42)" arranged on the locking strip (6). However, according to the description, the locking surface on the locking groove is designated "(42)" and the locking surface on the locking strip is designated "(60)".

Further, claim 6 defines a locking surface arranged on a "lower lip (21)" of the strip groove (36) and a locking surface on a "lower surface of said locking strip (6)". However, from the description, it seems that the locking surfaces are on an upper lip of the strip groove (36) and on an upper surface of the locking strip (6).

Claim 45 mentions a "positioning surface (67)", which should be a characteristic of the floorboard. However, according to the description and figure 9d, the positioning surface (67) is a surface on the locking strip (6). Thus, the positioning surface is not clearly defined. It could also be questioned whether the positioning surface (67) is "facing the vertical plane VP" or the opposite.

The claims seem to need reformulation.

Figs 35a-e show an embodiment with a separate flexible tongue and taking-up of a floorboard.

Figs 36a-c show a method of detaching floorboards having a separate strip.

Figs 36d-f show how prior art locking systems may be adapted for use with the herein disclosed separate strip.

Description of Embodiments of the Invention

A first preferred embodiment of a floorboard 1, 1' provided with a mechanical locking system according to the invention will now be described with reference to Figs 9a-d. To facilitate understanding, the locking system is shown schematically. It should be emphasised that an improved function can be achieved using other preferred embodiments that will be described below.

Fig. 9a illustrates schematically a cross-section through a joint between a long side edge portion 4a of a board 1 and an opposite long side edge portion 4b of a second board 1'.

The upper sides of the boards are essentially positioned in a common horizontal plane HP, and the upper parts of the joint edge portions 4a, 4b abut against each other in a vertical plane VP. The mechanical locking system provides locking of the boards relative to each other in the vertical direction D1 as well as the horizontal direction D2.

To provide joining of the two joint edge portions in the D1 and D2 directions, the edges of the floorboard have in a manner known per se a tongue groove 23 in one edge portion 4a of the floorboard and a tongue 22 formed in the other joint edge portion 4b and projecting past the vertical plane VP.

In this embodiment, the board 1 has a body or core 30 of wood-fibre-based material.

The mechanical locking system according to the invention comprises a separate strip 6 which has a pro-

jecting portion P2 projecting past the vertical plane and having a locking element. The separate strip also has an inner part P1 which is positioned inside the vertical plane VP and is mechanically joined with the floorboard 1. The locking element 8 coacts in prior-art manner with a locking groove 14 in the other joint edge portion and locks the floorboards relative to each other in the horizontal direction D2.

The floorboard 1 further has a strip groove 36 in one joint edge portion 4a of the floorboard and a strip tongue 38 in the inner part P1 of the separate strip 6.

The strip groove 36 is defined by upper and lower lips 20, 21 and has the form of an undercut groove 43 with an opening between the two lips 20, 21.

The different parts of the strip groove 36 are best seen in Fig. 9c. The strip groove is formed in the body or core 30 and extends from the edge of the floorboard. Above the strip groove there is an upper edge portion or joint edge surface 40 which extends all the way up to the horizontal plane HP. Inside the opening of the strip groove there is an upper engaging or supporting surface 41, which in the case is parallel to the horizontal plane HP. This engaging or supporting surface passes into a locking surface 42. Inside the locking surface there is a surface portion 49 forming the upper boundary of the undercut portion 33 of the strip groove and a surface 44 forming the bottom of the undercut groove. The strip groove further has a lower lip 21. On the upper side of this lip there is an engaging or supporting surface 46. The outer end of the lower lip has a lower joint edge surface 47 and a positioning surface 48. In this embodiment, the lower lip 21 does not extend all the way to the vertical plane VP.

The shape of the strip tongue is also best seen in Fig. 9d. In this preferred embodiment, the strip tongue is made of a wood-based board material, for instance HDF.

The strip tongue 38 of the separate strip 6 has a strip locking element 39 which coacts with the undercut groove 43 and locks the strip onto the joint edge portion 4a of the floorboard 1 in the horizontal direction D2. The strip tongue 38 is joined with the strip groove by means of a mechanical snap joint. The strip locking element 39 has a strip locking surface 60 facing the vertical plane VP, an upper strip surface 61 and an inner upper guiding part 62 which in this embodiment is inclined. The strip tongue also has an upper engaging or supporting surface 63, which in this case extends all the way to an inclined upper strip tongue part 64 at the tip of the tongue. The strip tongue further has a lower guiding part 65 which in this embodiment passes into a lower engaging or supporting surface 66. The supporting surface passes into a lower positioning surface 67 facing the vertical plane VP. The upper and lower engaging surfaces 45, 63 and 46, 66 lock the strip in the vertical direction D1. The strip 6 is in this embodiment made of a board material containing wood fibres, for instance HDF.

Figs 10a-c illustrate schematically how the separate strip 6 is integrated with the floorboard 1 by snap action. When the floorboard 1 and the strip 6 are moved towards each other according to Fig. 10a, the lower guiding part 65 of the strip tongue will coact with the joint edge surface 47 of the lower lip 21. According to Fig. 10b, the strip groove 36 opens by the upper lip 20 being bent upwards and the lower lip 21 downwards. The strip 6 is moved until its positioning surface 67 abuts against the positioning surface 48 of the lower lip. The upper and the lower lip 20, 21 snap backwards and the locking surfaces 42, 60 lock the strip 6 into the floorboard 1 and prevent separation in the horizontal direction. The strip tongue 38 and the strip groove 36 prevent separation in the vertical direction D1. The locking element 8 and its locking surface 10 will by this type of snap motion be exactly positioned relative to the upper joint

edge of the floorboard and the vertical plane VP. Thus, by this snap motion the floorboard has been integrated with a machined strip which in this embodiment is made of a separate sheet-shaped and wood-fibre-based material.

Figs 11a-c show how a strip blank 15 consisting of a plurality of strips 6 is made by machining. T1 - T4 indicate machining tools, preferably of diamond type, operating from above and from below. Only two tools T1 and T2 are necessary to produce a strip 6. In the first manufacturing step according to Fig. 11a, a strip 6 is made. However, this strip is not separated from the strip blank. In the next machining, the strip blank 15 is moved sideways a distance corresponding to the width of two strips. In the third manufacturing step, this step is repeated and now two more strips are manufactured. The strip blank thus grows by two strips in each run through the machine. Figs 12a-c show how the strip blank 15 with a plurality of strips 6 can be manufactured in a double-sided milling machine with four tools on each side. In the first manufacturing step according to Fig. 12a, two strips are manufactured. In the next manufacturing step, Fig. 12b, four more strips are manufactured. Fig. 12c shows that the strip blank consists of 10 strips after three steps. With a double-sided machine, which has, for instance, 8 milling motors and 8 tools on each side, 8 strips can be made in each run through the milling machine. Since machining can take place in e.g. HDF which does not have a surface layer, machining speeds of up to 200 m/min can be achieved with 8 strips in each run. Since normal flooring lines machine the joint edges by about 100 m/min, such a line can provide 16 flooring lines with strip blanks. The strips are made of a board material which can be considerably thinner than the floorboard. The cost of a separate strip with a width of 15-20 mm, made of an HDF board having a thickness of, for instance, 5 mm, is less than 30% of the waste cost in machining an 8 mm laminate floorboard with an integrated

strip which has an extent outside the joint edge corresponding to about 8-10 mm.

Several variants may exist. A strip blank can be manufactured in conventional planers. Special machines can be used consisting of e.g. an upper and a lower shaft with tools operating vertically. The floorboard is advanced by means of rolls which press the floorboard against vertical and lateral abutments and against the rotating tools.

An important feature according to the present invention thus is that the separate strip is made by mechanical machining of a sheet-shaped material.

Fig. 13 shows a plurality of strip blanks which can be stacked and handled rationally. It is possible to manufacture strip blanks which are as long as length and width of the floorboard and which consist of 10-12 strip blanks or more. The length of the strips may vary, for instance, between 70 and 2400 mm. The width can be, for instance, about 10-30 mm. The strip blanks can be made with fracture lines for separation of the strips. In HDF, such fracture lines can be made so that the thickness of material amounts to merely, for instance, about 0.5 mm. The strip blanks may then be joined with e.g. strings of hot-melt adhesive to long bands which may then be rolled up.

Figs 14a-d show a manufacturing method for integrating the strip with the floorboard. The strip blank 15 is fed between upper and lower supports 17, 18 towards a stop member 16 so that the strip 6 will be correctly positioned. The floorboard 1 is moved towards the strip according to Fig. 14b so that snapping-in takes place. Then the strip 6 is separated from the strip blank 15, for instance, by the strip being broken off. Subsequently this manufacturing step is repeated according to Fig. 14d. The equipment required for this snapping-in is relatively simple, and manufacturing speeds corresponding to normal flooring lines can be obtained. The strip 6 can

in this manner be snapped onto both long side and short side. It is obvious that a number of variants of this manufacturing method are feasible. The strip 6 can be moved towards the floorboard at different angles. Snapping-in can be combined with an angular motion. Inward angling with a minimum, or no, snapping-in may also be used. Inward angling to a state of friction or even pretension between the respective locking surfaces of the strip and the floorboard may be used. The strip may be attached when the board stands still or when it is moving. In the latter case, part of the strip is pressed against the joint edge portion of the floorboard adjacent to a corner between a long side and a short side. Then the remaining part of the strip can be rolled, pressed or angled towards the joint edge. Combinations of one or more of these methods may be used within one side or between different sides. The strip can be separated in a number of other ways, for instance, by cutting off, sawing etc, and this can also take place before fastening.

Figs 15a-d show a production-adjusted variant of the invention. In this embodiment, the upper and lower lips 20, 21 of the strip groove 36 as well as the upper and lower engaging surfaces 63, 66 of the strip tongue are inclined relative to the horizontal plane HP and they follow lines L1 and L2. This significantly facilitates snapping the strip into the floorboard 1. The lower lip 21 has been made longer and the locking element of the strip and the locking surface of the undercut groove are inclined. This facilitates manufacture and snapping-in. In this embodiment, the positioning of the strip in connection with snapping-in takes place by part of the upper guiding part 62 coacting with the bottom 44 of the undercut groove. The locking element 14 has a locking surface 10 which has the same inclination as the tangent TC to the circular arc with its centre in the upper joint edge. Such an embodiment facilitates inward angling but requires that the projecting portion P" should have an

extent which is preferably the same size as the thickness T of the floorboard for the locking surface of the locking element to have a sufficiently high angle relative to the underside of the board. A high locking angle increases the locking capability of the locking system. The separate strip allows joint geometries with an extended projecting portion P2 without this causing greater costs in manufacture. An extended inner part P1 facilitates integration by snap action and results in high fastening capability. The following ratios have been found particularly favourable. P2 > T and P1 > 0.5T. As a non-limiting example it may be mentioned that a satisfactory function can already be achieved when P2 is 0.8 *T or larger. Fig. 15b shows inward angling with a play between the locking element 8 and the locking groove 14 during the initial phase of the inward angling when the upper joint edges touch each other and when parts of the lower part of the locking groove 14 are lower than the upper part of the locking element 8. Fig. 15d shows snapping-in of the floorboard 1' into the floorboard 1. A separate strip 6 which is mechanically integrated with the floorboard 1 facilitates snapping-in by the strip 6 being able to move in a rotary motion in the strip groove 36. The strip can then turn as indicated by line L3. The remaining displacement downwards of the locking element 8 to the position L4 can be effected in prior-art manner by downward bending of the strip 6. This makes it possible to provide locking systems which are capable of snapping and angling on long side as well as short side and which have a relatively high locking element 8. In this way, great strength and good capability of inward angling can be combined with the snap function and a low cost. The following ratio has been found favourable. HL > 0.15 T. This can also be combined with the above ratios.

Figs 16a-d show snapping-in of the strip 6 in four steps. As is evident from the Figures, the inclined surfaces allow the snapping-in of the strip 6 into the

floorboard 1 to be made with a relatively small bending of the upper and lower lips 20 and 21.

Fig. 17 shows manufacture of a strip blank where all three critical locking and positioning surfaces are made using a divided tool which contains two adjustable tool parts T1A and T1B. These tool parts are fixed in the same tool holder and driven by the same milling motor. This divided tool can be ground and set with great accuracy and allows manufacture of the locking surfaces 10 and 60 as well as the positioning surface 62 with a tolerance of a few hundredths of a millimetre. The movement of the board between different milling motors and between different manufacturing steps thus does not result in extra tolerances.

Figs 18a-d show an embodiment of the invention where also the tongue 22 is made of a separate material. This embodiment can reduce the waste still more. Since the tongue locks only vertically, no horizontal locking means other than friction are required to fasten the tongue in the floorboard 1'.

Figs 19a-d show another embodiment of the invention which is characterised in that the projecting portion has a locking element which locks in an undercut groove in the board 1'. Such a locking system can be locked by angling and snapping and it can be unlocked by upward angling about the upper joint edge. Since the floorboard 1' has no tongue, the amount of wasted material can be minimised.

Figs 20a-e show an embodiment of the invention which is characterised in that the separate strip 6 consists of two symmetric parts, and that the joint portions of the floorboards 1, 1' are identical. This embodiment allows simple manufacture of, for instance, boards which may consist of A and B boards which have mirror-inverted locking systems. The locking system of the preferred geometry is not openable. This can be achieved, for

instance, by rounding of the lower and outer parts of the strip 6.

Figs 21-26 illustrate variants of the invention. Fig. 21 shows an embodiment with lower lips 21 which extend essentially to the vertical plane.

Fig. 22 shows an embodiment with locking elements on the upper and lower sides of the strip 6.

Fig. 23 shows a separate strip which is visible from the surface and which may constitute a decorative joint portion. An HDF strip can be coloured and impregnated. A strip of e.g. compact laminate can have a decorative surface part which is moisture proof and has high wearing strength. The strip can be provided with a rubber coating counteracting penetration of moisture. Preferably the strip should be attached to the long side only and preferably in such a manner that part of the strip projects from the surface at the short sides of the floorboard. This attachment should be made after machining of the long side but before machining of the short side. The surplus material can then be removed in connection with machining of the short sides and the strip will have a length corresponding to the length of the surface layer. Decorative strips can be made without visible joints. The strip-locking elements are in this embodiment positioned in the lower lip 21.

Fig. 24 shows a separate strip with a tapering projecting portion which improves the flexibility of the strip.

Fig. 25 shows an embodiment where the inner portion P1 of the strip has a strip groove 36. This may facilitate snapping-in of the strip since also the strip groove 36 is resilient by its lip 21a also being resilient. The strip groove can be made by means of an inclined tool according to prior art. This embodiment is also characterised in that the inner portion P1 has two locking elements.

Fig. 26 shows an embodiment where the inner portion P1 has no locking element. The strip 6 is inserted into the strip groove until it abuts against the lower positioning surface and is retained in this position by frictional forces. Such an embodiment can be combined with gluing which is activated in a suitable prior-art manner by heating, ultrasound etc. The strip 6 can be preglued before being inserted.

Figs 27a and b show two variants which facilitate separation by the strip 6 being separated from the strip 6' by being broken off. In Fig. 27a, the strip 6 is designed so that the outer part of the strip tongue 33 is positioned on the same level as the rear part of the locking element 8. Breaking-off takes place along line S. Fig. 27b shows another variant which is convenient especially in HDF material and other similar materials where the fibres are oriented essentially horizontally and where the fracture surface is essentially parallel to the horizontal plane HP. Breaking-off takes place along line S with an essentially horizontal fracture surface.

Figs 28a and b show how the amount of wasted material can be minimised in embodiments of the invention where the joint edge is formed with a tongue. Sawing can take place with an upper sawblade SB1 and a lower sawblade SB2 which are laterally offset. The floor elements 2 and 2' will only have an oversize as required for rational machining of the joint edges without taking the shape of the tongue into consideration. By such an embodiment, the amount of wasted material can be reduced to a minimum.

Figs 29a-e show machining of joint edge portions using diamond cutting tools. A tool TP1 with engaging direction WD machines the laminate surface in prior-art manner and performs premilling. A minimum part of the laminate surface is removed. According to Fig. 29b, the strip groove is made and the tool TP2 operates merely in the core material and the rear side. Fig. 29c shows how

the undercut groove with the locking surface and an upper and a lower positioning surface are formed. All critical surfaces that are essential for the horizontal positioning and locking of the strip can thus be formed with great accuracy using one and the same tool. Fig. 29e shows how the corresponding machining can be carried out using an inclined tool TP5. Finally the upper joint edge is machined by means of the tool TP4 in prior-art manner. The joint geometry and the manufacturing methods according to the invention thus make it possible to manufacture floorboards with advanced locking systems. At the same time machining of the joint edges can be carried out using fewer tools than normal, with great accuracy and with a minimum amount of wasted material. Wooden flooring does not require a premilling tool TP1 and machining may therefore take place using three tools only. This method thus makes it possible to provide a locking system with a wood-fibre-based strip which extends past the vertical plane while at the same time the manufacture of said locking system at the groove/strip side can take place inside the vertical plane. The method thus combines the advantages of an inexpensive and projecting wood fibre strip and manufacture that does not need to remove large parts of the difficult surface layer.

Fig. 30 illustrates a normal laminate floorboard with strips 6b and 6a according to the invention on a long side 4 and a short side 3. The strips can be of the same material and have the same geometry but they may also be different. The invention gives great possibilities of optimising the locking systems on the long side and short side as regards function, cost and strength. On the short sides where the strength requirements are high and where snapping-in is important, advanced, strong and resilient materials such as compact laminate can be used. In long and narrow formats, the long side contains essentially more joint material, and therefore it has been necessary in traditional locking systems to reduce the

extent of the strip outside the joint edge as much as possible. This has made snapping-in difficult or impossible, which is an advantage in certain laying steps where inward angling cannot take place. These limitations are largely eliminated by the present invention. Fig. 31 shows a long and narrow floorboard which necessitates a strong locking system on the short side. The saving in material that can be made using the present invention in such a floorboard is considerable.

Figs. 32a-b show formats resembling parquet blocks. A mechanical locking system of a traditional type can in such a format, for instance 70*400 mm, cause an amount of wasted material of more than 15%. Such formats are not available on the market as laminates. According to the present invention, these formats can be manufactured rationally with a mechanical locking system which is less expensive than also traditional systems using tongue, groove and glue. They can also, as shown in these two Figures, be manufactured with a mirror-inverted system where the strip on the short side is alternately snapped into the upper and lower short sides.

Fig. 33 shows a format with a wide short side. Such a format is difficult to snap in since downward bending of the long strip 6a on the short side means that a great bending resistance must be overcome. According to the present invention, this problem is solved by the possibility of using flexible materials in the separate strip which also according to the description above can be made partially turnable in the inner portion.

Figs 33a-c show a production-adjusted embodiment with a separate strip 6 which has cooperating horizontal locking surfaces 60, 42 in the lower lip 21. Figs 33b and c show how the strip is snapped on in a somewhat angled position. Snapping-in can take place with downward bending of the lower lip 21 which can be limited to, for instance, half the height of the strip-locking element 39. Thus the lower lip can be relatively rigid, which

prevents snapping-out in case of tensile load. An advantage of this embodiment is also that when the floorboards 1, 1' are joined and subjected to tensile load, the tongue 22 will prevent the strip 6 from sliding upwards. In this embodiment the strip will have a stronger attachment when the floorboards are joined than in the case where the floorboards are unmounted. The strip 6 can also easily be taken up by upward angling and this is an advantage when floorboards are laid against a wall in the first or last row.

Figs 34a-34c show different embodiments with the lower lip outside and inside the vertical plane VP. The embodiment in Fig. 34a can be applied to the short side when the projecting lower lip effects strong locking between the lower lip and the locking strip 6 while at the same time the loss of material is of limited extent. Fig. 34c shows a strong locking system with double horizontal locking means 14, 8 and 14', 8'. The separate strip 6 allows the undercut locking groove 14' to be made in a simple manner using large rotating tools since in connection with this manufacture there is no strip 6 at the joint edge portion.

Figs 35a-e show how a joint system can be made with a flexible tongue 22 which can be displaced and/or compressed horizontally H1, H2 or alternatively be bent vertically up V1 or down V2. Fig. 35a shows a separate tongue 22 of, for instance, wood fibre material which can be displaced horizontally in the H1, H2 direction by means of a flexible material 70, for instance a rubber paste. Fig. 35b shows an embodiment with a tongue 22 which has an inner part that is resilient. Figs 35c-d show how a flexible tongue can be dimensionally changed so that locking and unlocking can take place with a vertical motion. Fig. 35e shows how a first floorboard 1' can be detached by upward angling using e.g. suction cups or suitable tools that are applied to the floorboard edge closest to the wall. The floorboard has on a long side

and a short side flexible tongues 22' and 22. After upward angling, an adjoining floorboard in the same row R2 can be detached and optionally be laid again in the same way. When the entire row is detached, the rows R1 and R3 can be taken up in a prior-art manner. Floorboards with such a preferred system has great advantages, above all in large floors. Floorboards can be exchanged in any row. A damaged floorboard in the centre of a floor can, with most of today's locking systems, only be exchanged if half the floor is taken up. For instance, the floor may consist of one or more rows of the above-mentioned floorboards in the portions where the taking-up possibility is particularly important. The tongue 22 should preferably be made of flexible material, such as plastic. Wood-fibre-based materials can also be used, for instance HDF. Vertical taking-up is facilitated if the flexible tongue is combined with a strong and flexible loose strip which has a preferably strong and flexible locking element having smooth locking surfaces with low friction.

Figs 36a-36b show how a joint system with a separate strip can be designed to allow an angular motion in prior-art manner with the rear sides of the floorboards against each other. Such systems are available only with the strip made in one piece with the core of the floorboard and are difficult to use. Fig. 36b shows how the floorboards 1, 1', in relative backward bending through about 10 degrees, detach the tongue side in the floorboard 1 which can be detached at half the angle, in this case about 5 degrees. With this method, individual boards cannot be detached. At least two rows must usually be angled upward at the same time. Backward angling is facilitated significantly if the strip is wide, has low friction and is flexible. A rotary motion in the groove where the strip 6 is attached is also advantageous. All this can be achieved with a separate strip adapted to this function.

It is obvious that a large number of variants of preferred embodiments are conceivable. First, the different embodiments and descriptions can be combined wholly or partly. The inventor has also tested a number of alternatives where geometries and surfaces with different angles, radii, vertical and horizontal extents and the like have been manufactured. Bevelling and rounding-off can result in a relatively similar function. A plurality of other joint surfaces can be used as positioning surfaces. The thickness of the strip may be varied and it is possible to machine materials and make strips of board materials that are thinner than 2 mm. A large number of known board materials, which can be machined and are normally used in the floor, building and furniture industries, have been tested and found usable in various applications of the invention. Since the strip is integrated mechanically, there are no limitations in connection with the attachment to the joint edge as may be the case when materials must be joined with each other by means of gluing.

Most prior-art locking systems can, as exemplified in Figs 36d-36f, be adjusted for use of a separate locking strip, as described above. It will thus be appreciated that a locking strip made by machining of a sheet-shaped material, for instance a wood-based material, need not necessarily exhibit all the features stated in the appended claims. It will also be appreciated that the locking strip can also be made, for instance, by extrusion or injection moulding of polymeric or metallic materials, in which case, for instance, the geometries, shown herein, of both locking strip and joint edge of the floorboard may be utilised.

CLAIMS

1. A floorboard (1) comprising connecting means (6, 8, 14) which are integrated with the floorboard and adapted to connect the floorboard with an essentially identical floorboard (1'),

so that upper joint edges of said floorboard and said essentially identical floorboard in the connected state define a vertical plane (VP),

said connecting means (6, 8, 14) being designed to connect said floorboard (1) with said essentially identical floorboard (1') in at least a horizontal direction (D2) perpendicular to said vertical plane (VP),

said connecting means comprising a locking strip (6) which projects from said vertical plane (VP) and carries a locking element (8) which is designed to cooperate, in said connected state, with a locking groove (14) of said essentially identical floorboard,

said locking strip (6) consisting of a separate part which is arranged on the floorboard (1), and

said locking strip (6) in said horizontal (D2) and vertical (D1) directions being mechanically fixed to the floorboard (1),

c h a r a c t e r i s e d in that

the locking strip (6) is mechanically fixed to the floorboard (1) by means of a joint which is operable by snapping-in and/or inward angling, and

the locking strip is designed for connecting the floorboard with the essentially identical floorboard (1') by at least inward angling.

2. A floorboard as claimed in claim 1, c h a r a c t e r i s e d in that said connecting means (6, 8, 14) are designed to connect the floorboard with the essentially identical floorboard also by snapping-in in an essentially horizontal direction (D2).

3. A floorboard as claimed in claim 1, c h a r - a c t e r i s e d in that said connecting means (6, 8, 14) are designed to disconnect said floorboard (1) from said essentially identical floorboard (1') by an angular motion in a direction opposite to said inward angling.

4. A floorboard as claimed in any one of claims 1-3, c h a r a c t e r i s e d by a strip groove (36) which is designed to receive said locking strip (6), and a tongue groove (23) which, for connection in a vertical direction (D1) perpendicular to a principal plane of the floorboard (1), is designed to receive a tongue (22) arranged on said essentially identical floorboard (1'), at least one surface (60) of said tongue groove (23) consisting of said locking strip (6).

5. A floorboard as claimed in claim 4, c h a r - a c t e r i s e d by a locking surface (60) arranged on said locking groove (36) and adapted to cooperate with a locking surface (42) arranged on said locking strip (6).

6. A floorboard as claimed in claim 5, c h a r - a c t e r i s e d in that said locking surface (60) arranged on the locking groove is arranged on a lower lip (21) which defines said strip groove (36), and that said locking surface (42) arranged on the locking strip is arranged on a lower surface of said locking strip (6).

7. A floorboard as claimed in claim 6, c h a r - a c t e r i s e d in that the locking strip (6) forms an extension of said lower lip (21).

8. A floorboard as claimed in claim 6 or 7, c h a r a c t e r i s e d in that said lower lip (21) projects from said vertical plane (VP).

9. A floorboard as claimed in any one of claims 4-8, c h a r a c t e r i s e d in that said tongue (22) consists of a separate part which is designed to engage, in said connected state, in said tongue groove (23) and in a corresponding groove in said essentially identical floorboard (1').

10. A floorboard as claimed in claim 9, c h a r a c t e r i s e d in that said tongue (22) is horizontally displaceable and/or elastically deformable.

11. A floorboard as claimed in any one of the preceding claims, c h a r a c t e r i s e d in that the locking strip (6) is detachable from said floorboard (1) by an angular motion in a direction opposite to said inward angling.

12. A floorboard as claimed in any one of the preceding claims, c h a r a c t e r i s e d in that the locking strip (6) essentially consists of a machined sheet-shaped material.

13. A floorboard as claimed in claim 12, c h a r a c t e r i s e d in that the locking strip (6) is formed by machining.

14. A floorboard as claimed in any one of the preceding claims, c h a r a c t e r i s e d in that the locking strip (6) essentially is made of wood-based material.

15. A floorboard as claimed in claim 14, c h a r a c t e r i s e d in that said wood-based material is selected from the group consisting of pure wood, particle board, plywood, HDF, MDF and compact laminate.

16. A floorboard as claimed in claim 14 or 15, c h a r a c t e r i s e d in that said wood-based material is impregnated and/or coated with a property-improving agent.

17. A floorboard as claimed in any one of claims 14-16, c h a r a c t e r i s e d in that said wood-based material comprises a curing polymer material.

18. A floorboard as claimed in any one of claims 14-17, c h a r a c t e r i s e d in that said wood-based material is formable by machining.

19. A floorboard as claimed in any one of the preceding claims, c h a r a c t e r i s e d in that the floorboard (1) is quadrilateral and, along at least two mutually perpendicular edge portions (5a, 4a), has first (6', 8', 14') and second (6, 8, 14) sets of connecting means.

20. A floorboard as claimed in any one of the preceding claims, c h a r a c t e r i s e d in that said first set of connecting means (6', 8', 14') are arranged on the short side (5a) of the floorboard and said second set of connecting means (6, 8, 14) are arranged on the long side (4a) of the floorboard, said first connecting means (6', 8', 14') differing from said second connecting means (6, 8, 14) in terms of material property or material composition.

21. A floorboard as claimed in claim 20, c h a r a c t e r i s e d in that a locking strip (6') included in said first set of connecting means (6', 8', 14') differs in terms of material property or material composition from a locking strip (6) included in said second set of connecting means (6, 8, 14).

22. A floorboard as claimed in claim 21, c h a r - a c t e r i s e d in that the locking strip (6') included in said first set of connecting means (6', 8' 14') has higher strength than the locking strip (6) included in said second set of connecting means (6, 8, 14).

23. A method for manufacturing a floorboard (1') comprising connecting means (6, 8, 14) integrated with the floorboard and adapted to connect the floorboard (1) with an essentially identical floorboard (1'),

so that upper joint edges of said floorboard and said essentially identical floorboard in the connected state define a vertical plane (VP),

said connecting means (6, 8, 14) being designed to connect said floorboard (1) with said essentially identical floorboard (1') in at least a horizontal direction (D2) perpendicular to said vertical plane (VP),

said connecting means (6, 8, 14) comprising a locking strip (6) which projects from said vertical plane (VP) and carries a locking element (8) which is designed to cooperate, in said connected state, with a locking groove (14) of said essentially identical floorboard (1'), comprising the steps of

forming the locking strip (6) as a separate part which is arranged on the floorboard (1), and

mechanically fixing the locking strip (6) to the floorboard in both the horizontal and vertical directions,

c h a r a c t e r i s e d by

mechanically fixing the locking strip (6) to the floorboard (1) by means of a joint which is operable by snapping-in and/or inward angling, and

forming the locking strip (6) for connecting the floorboard with the essentially identical floorboard by at least inward angling.

24. A method as claimed in claim 23, c h a r a c - t e r i s e d by forming the locking strip (6) by machining of a sheet-shaped material.

25. A method as claimed in claim 23 or 24, c h a r a c t e r i s e d by fixing the locking strip (6) to the floorboard (1) by snapping-in in an essentially horizontal (D2) direction.

26. A method as claimed in any one of claims 23-25, c h a r a c t e r i s e d by fixing the locking strip (6) to the floorboard (1) by inward angling.

27. A method as claimed in claim 25 or 26, c h a r a c t e r i s e d in that said locking strip (6) is included in a strip blank (15) comprising at least two essentially identical locking strips, the locking strip (6) being engaged with the floorboard (1), and said locking strip being separated from said strip blank (15).

28. A locking strip (6) for connecting a floorboard (1) with an essentially identical floorboard (1')

so that upper joint edges of said floorboard (1) and said essentially identical floorboard (1') in the connected state define a vertical plane (VP),

said locking strip (6) being designed to mechanically connect said floorboard (1) with said essentially identical floorboard (1') in at least a horizontal direction (D2) perpendicular to said vertical plane (VP),

the locking strip (6) being designed to be fixed to the floorboard (1) so as to project from said vertical plane (VP) and carry a locking element (8) which is designed to cooperate, in said connected state, with a locking groove (14) of said essentially identical floorboard (1'), and

the locking strip (6) being designed to be mechanically fixed to the floorboard in both the horizontal (D2) and vertical (D1) directions,

c h a r a c t e r i s e d in that

the locking strip (6) is designed for mechanical fixing to the floorboard (1) by means of a joint, which is operable by snapping-in and/or inward angling, and

the locking strip (6) is designed for connecting the floorboard (1) with the essentially identical floorboard (1') by at least inward angling.

29. A locking strip as claimed in claim 28, c h a r a c t e r i s e d in that the locking strip (6) essentially consists of wood-based material.

30. A locking strip as claimed in claim 28 or 29, c h a r a c t e r i s e d in that the locking strip (6) has a cross-section which is asymmetrical about said vertical plane (VP).

31. A method for manufacturing a locking strip (6) for connecting a floorboard (1) with an essentially identical floorboard (1'),

so that upper joint edges of said floorboard (1) and said essentially identical floorboard (1') in the connected state define a vertical plane (VP), comprising

forming the locking strip (6) for mechanical connection of said floorboard (1) with said essentially identical floorboard (1') in at least a horizontal direction (D2) perpendicular to said vertical plane (VP),

forming the locking strip (6) for fixing to the floorboard (1) so that it projects from said vertical plane (VP) and carries a locking element (8) which is designed to cooperate, in said connected state, with a locking groove (14) of said essentially identical floorboard (1'), and

forming the locking strip (6) for mechanical fixing to the floorboard in both the horizontal (D2) and vertical (D1) directions,

c h a r a c t e r i s e d by

forming the locking strip (6) for mechanical fixing to the floorboard by means of a joint, which is operable by snapping-in and/or inward angling, and

forming the locking strip (6) for connecting the floorboard (1) with the essentially identical floorboard (1') by at least inward angling.

32. A method as claimed in claim 31, c h a r a c - t e r i s e d by forming the locking strip (6) by machining a sheet-shaped material.

33. A method as claimed in claim 31 or 32, c h a r a c t e r i s e d by forming the locking strip (6) by machining at least one side of the sheet-shaped material.

34. A method as claimed in claim 32 or 33, c h a r a c t e r i s e d by forming a strip blank (15) consisting of at least two locking strips by said machining of said sheet-shaped material.

35. A method as claimed in claim 34, c h a r a c - t e r i s e d by forming a fracture line between said at least two locking strips in said machining of said strip blank (15), said fracture line being formed to facilitate separation of one of said at least two locking strips.

36. A strip blank (15) consisting of at least two locking strips, which are each designed to connect a floorboard (1) with an essentially identical floorboard (1'),

so that upper joint edges of said floorboard (1) and said essentially identical floorboard (1') in the connected state define a vertical plane (VP),

each of said locking strips (6) being designed to mechanically connect said floorboard (1) with said essentially identical floorboard (1') in at least a horizontal direction (D2) perpendicular to said vertical plane (VP),

each of said locking strips (6) being designed to be fixed to the floorboard (1) so that it projects from said vertical plane (VP) and carries a locking element (8) which is designed to cooperate, in said connected state, with a locking groove (14) of said essentially identical floorboard (1'), and

each of said locking strips (6) being designed to be mechanically fixed to the floorboard (1) in both the horizontal (D2) and vertical (D1) directions,

c h a r a c t e r i s e d in that

each of said locking strips (6) is designed for mechanical fixing to the floorboard by means of a joint, which is operable by snapping-in and/or inward angling, and

each of said locking strip (6) is designed to connect the floorboard (1) with the essentially identical floorboard (1') by at least inward angling.

37. A strip blank as claimed in claim 36, c h a r a c t e r i s e d in that the strip blank (15) essentially consists of wood-based material.

38. A strip blank as claimed in claim 36 or 37, c h a r a c t e r i s e d in that each of said locking strips has a cross-section which is asymmetrical about said vertical plane (VP).

39. A strip blank as claimed in any one of claims 36-38, c h a r a c t e r i s e d in that the strip blank (15) is made in one piece of a sheet-shaped material.

40. A strip blank as claimed in any one of claims 36-39, c h a r a c t e r i s e d in that the strip blank (15) is designed to facilitate separation of a locking strip (6) included in said strip blank.

41. A strip blank as claimed in claim 40, c h a r - a c t e r i s e d in that the strip blank (15) is provided with a fracture line to facilitate separation of a locking strip (6) included in said strip blank.

42. A set of parts for making a floorboard (1) with connecting means (6, 8, 14) for connecting the floorboard (1) with an essentially identical floorboard (1'),

so that upper joint edges of said floorboard (1) and said essentially identical floorboard (1') in the connected state define a vertical plane (VP),

said connecting means (6, 8, 14) being designed to connect said floorboard (1) with said essentially identical floorboard (1') in at least a horizontal direction (D2) perpendicular to said vertical plane (VP),

said connecting means (6, 8, 14) comprising a locking strip (6) which projects from said vertical plane (VP) and carries a locking element (8) which is designed to cooperate, in said connected state, with a locking groove (14) of said essentially identical floorboard,

the locking strip (6) consisting of a separate part which is designed to be fixed to the floorboard (1), and

the locking strip (6) being designed to be mechanically fixed to the floorboard (1) both in the horizontal (D2) and vertical (D1) directions,

c h a r a c t e r i s e d in that

the locking strip (6) is designed for mechanical fixing to the floorboard (1) by means of a joint, which is operable by snapping-in and/or inward angling, and

the locking strip (6) is designed to connect the floorboard (1) with the essentially identical floorboard (1') by at least inward angling.

43. A set of parts as claimed in claim 42, characterised in that the locking strip (6) is included in a strip blank (15) comprising at least two essentially identical locking strips.

44. A floorboard (1) comprising connecting means (6, 8, 14) which are integrated with the floorboard and adapted to connect the floorboard with an essentially identical floorboard (1'),

so that upper joint edges of said floorboard and said essentially identical floorboard in the connected state define a vertical plane (VP),

said connecting means (6, 8, 14) being designed to connect said floorboard (1) with said essentially identical floorboard (1') in at least a horizontal direction (D2) perpendicular to said vertical plane (VP),

said connecting means comprising a locking strip (6) which projects from said vertical plane (VP) and carries a locking element (8) which is designed to cooperate, in said connected state, with a locking groove (14) of said essentially identical floorboard,

said locking strip (6) consisting of a separate part which is arranged on the floorboard (1), and

said locking strip (6) being mechanically fixed to the floorboard (1) in said vertical (D1) direction,

characterised in that

the locking strip (6) is inserted into a strip groove (36) arranged in the edge portion of said floorboard (1), whereby the locking strip is held in place in said horizontal direction (D2) by frictional forces or glue, and

the locking strip is designed for connecting the floorboard with the essentially identical floorboard (1') by at least inward angling.

45. The floorboard as claimed in claim 44, characterised by a positioning surface (67) facing the vertical plane VP.

46. A floorboard as claimed in claim 44 or 45, characterised in that the locking strip (6) essentially consists of a machined sheet-shaped material.

47. A floorboard as claimed in claim 46, characterised in that the locking strip (6) is formed by machining.

48. A floorboard as claimed in any one of claims 44-47, characterised in that the locking strip (6) essentially is made of wood-based material.

49. A floorboard as claimed in claim 48, characterised in that said wood-based material is selected from the group consisting of pure wood, particle board, plywood, HDF, MDF and compact laminate.

50. A floorboard as claimed in claim 48 or 49, characterised in that said wood-based material is impregnated and/or coated with a property-improving agent.

51. A floorboard as claimed in any one of claims 48-50, characterised in that said wood-based material comprises a curing polymer material.

52. A floorboard as claimed in any one of claims 48-51, characterised in that said wood-based material is formable by machining.